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OPERATION
AND
SERVICE MANUAL

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TELONIC INSTRUMENTS
A Division of Telonic Industries, Inc.
60 N. First Avenue
Beech Grove, Indiana 46107

OPERATION
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SERVICE MANUAL
T.O.S. NO. 117B

MODEL HD-7
SWEEP GENERATOR

TM
TELONIC INSTRUMENTS
A Division of Telonic Industries, Inc.
60 N. First Avenue
Beech Grove, Indiana 46107
telonic

NEW LOCATION
TELONIC INDUSTRIES, INC.
BOX 277
LAGUNA BEACH, CALIFORNIA
92652

TEL (317) 787-3231 TWX-810-341-3202

WARRANTY

TELONIC INSTRUMENTS AND ACCESSORIES

Products manufactured by TELONIC INSTRUMENTS; Division of Telonic Industries, Inc. are guaranteed against defective materials and workmanship for a period of one year (vacuum tubes excepted) from date of purchase. This warranty does not apply to instruments that have been altered, improperly handled or damaged in any way beyond our control.

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications, without incurring any liability to modify equipment previously sold.

RETURNING EQUIPMENT TO FACTORY

Factory service is available for repair and readjustment of this instrument. However, a description of the trouble, plus the MODEL AND SERIAL NUMBERS of the unit must be forwarded FIRST, whereupon instructions for correcting the trouble OR authorization for returning the equipment will be given. This applies to all units, whether under warranty or not. Contact TELONIC INSTRUMENTS at Post Office Box 87, Beech Grove, Indiana 46107 or your local TELONIC representative.

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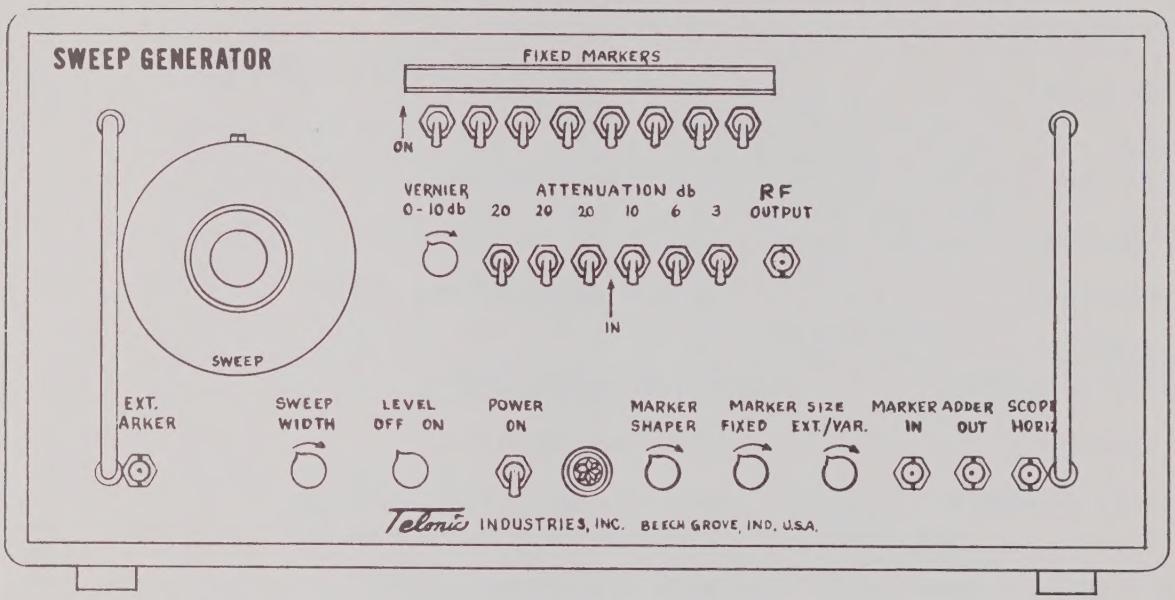
TELONIC INDUSTRIES, INC.
BOX 277
LAGUNA BEACH, CALIFORNIA
92652

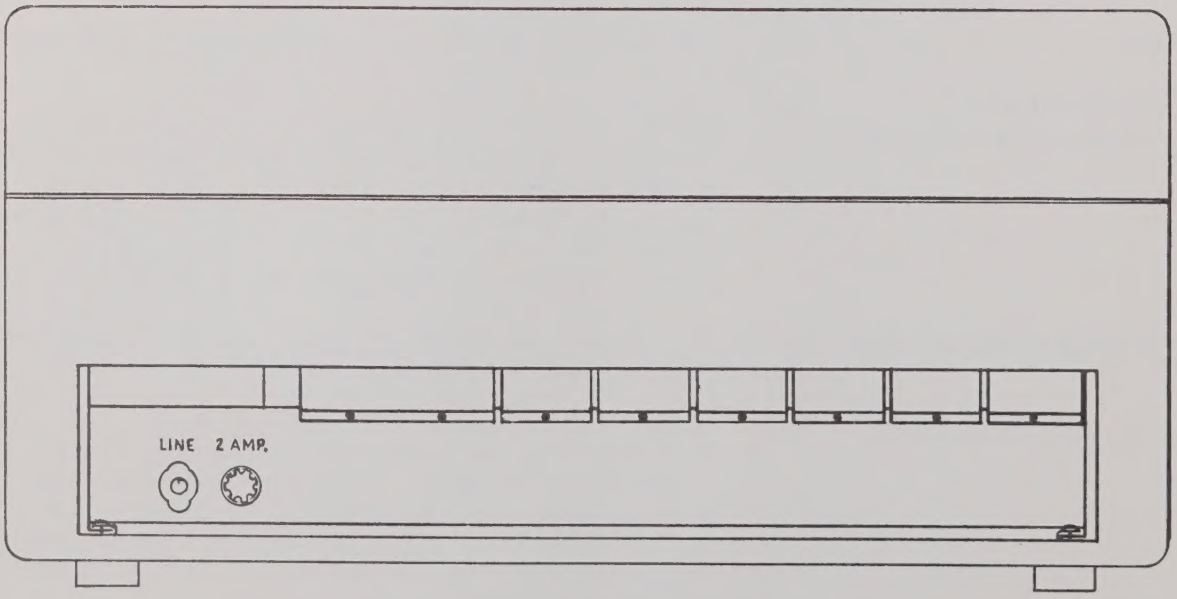
SPECIFICATIONS

MODEL HD-7 SWEEP GENERATOR

CENTER FREQUENCY	100 KC to 75 MC
FREQUENCY RANGE	100 KC to 100 MC
SWEEP WIDTH	100 KC to 50 MC
OUTPUT	
Voltage	1 volt peak to peak
Impedance	50 ohms
Flatness	5% over maximum sweep width
ATTENUATION	
Toggle Switch	20,20,20,10,6,3 db.
Vernier	0 to over 10 db.
DISPLAY LINEARITY	Normally below 1.2:1 @ 60 cps., Normally below 1.4:1 @ 50 cps.
RADIATION	Less than 10 microvolts
SWEEP RATE	Line frequency (50-60 cps.)
ZERO BASE LINE	Oscillator off 50% of the time during return sweep.
SCOPE HORIZONTAL SWEEP	Approximately 20 volts peak to peak.
SOURCE VSWR	Normally below 1.2:1
POWER	115/230 Vac., 50/60 cps., Approximately 120 watts
MARKER SYSTEM	
Plug-In Crystal Markers	Provisions are included for up to eight single frequency or harmonic type plug-in crystal-controlled markers. These markers are optional and may be included in this instrument or added at a later date. See our literature for further details regarding these markers.
External Marker Input	An external CW signal of approximately 0.1 volts may be used to produce a "birdy" type marker.
Birdy-By-Pass Marker	The output of the marker oscillators is mixed with a signal from the sweep oscillator to produce beatnotes or birdies. These are amplified and superimposed upon the detected RF output signal before it is applied to the vertical scope input. Amplitude and shape of the markers are adjustable over a wide range.
PHYSICAL DESCRIPTION	Panel Size 1/8" x 8 3/4" x 19" Chassis Size 2" x 14 1/2" x 17"


SWEEP GENERATOR
FIXED MARKERS
ON
VERNIER
0 - 10 db
ATTENUATION db
20 20 20 10 6 3
RF
OUTPUT
IN
SWEEP
EXT.
ARKER
SWEEP
WIDTH
LEVEL
OFF ON
POWER
ON
MARKER
SHAPER
MARKER
FIXED
SIZE
EXT./VAR.
MARKER
IN
ADDER
OUT
SCOPE
HORIZ
Telonic INDUSTRIES, INC. BEECH GROVE, IND. U.S.A.

FRONT

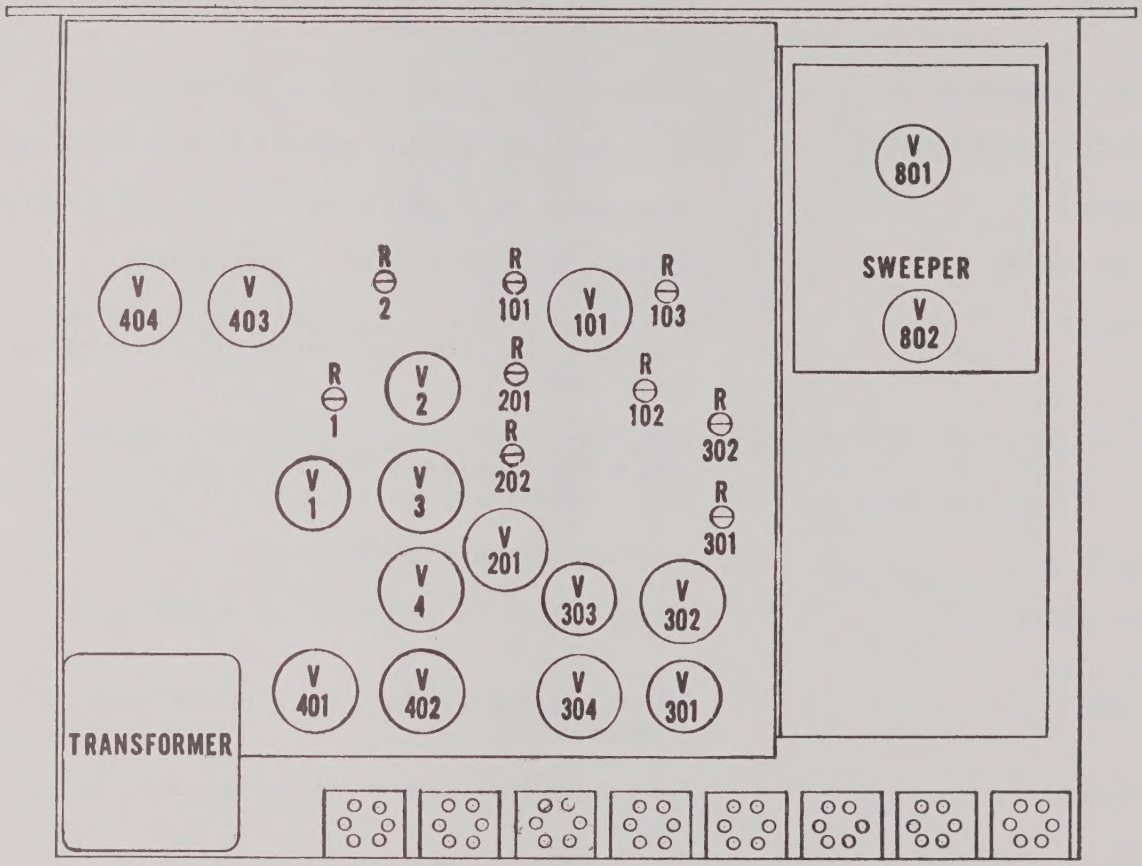

LINE 2 AMP.

REAR

DESCRIPTION OF FRONT PANEL

SWEEP DIAL	Indicates center frequency of the sweep oscillator at minimum sweep width.
VERNIER ATTENUATION	Provides 0-10 db. of vernier attenuation.
TOGGLE SWITCH ATTENUATOR	Provides the indicated amounts of step attenuation.
RF OUTPUT	RF sweep output - BNC Connector - impedance 50 ohms.
EXTERNAL MARKER	Marker input for external signal source.
SWEEP WIDTH	Varies the amount of voltage supplied to the vibrating capacitor and can be used to vary the sweep width.
LEVEL ON/OFF	Should be in ON position when operating at frequencies above 500 KC and OFF position when operating at frequencies below 500 KC.
POWER ON	Switches AC power ON and OFF.
MARKER SHAPER	Varies the width of the marker signals.
MARKER SIZE	
FIXED	Varies the amplitude of the fixed markers (crystal plug-in units).
EXT/VAR	Varies the amplitude of the external marker signal.
MARKER ADDER	
IN	The demodulated signal from the device being tested is fed into this connector so that marker signals may be superimposed.
OUT	This connector should be connected to the vertical input terminals of the scope for viewing the demodulated signal and markers.
SCOPE HORIZONTAL	This connector should be connected to the scope horizontal amplifier input.
FIXED MARKERS	These switches supply B+ to the fixed markers (crystal plug-in units) when in the ON position.

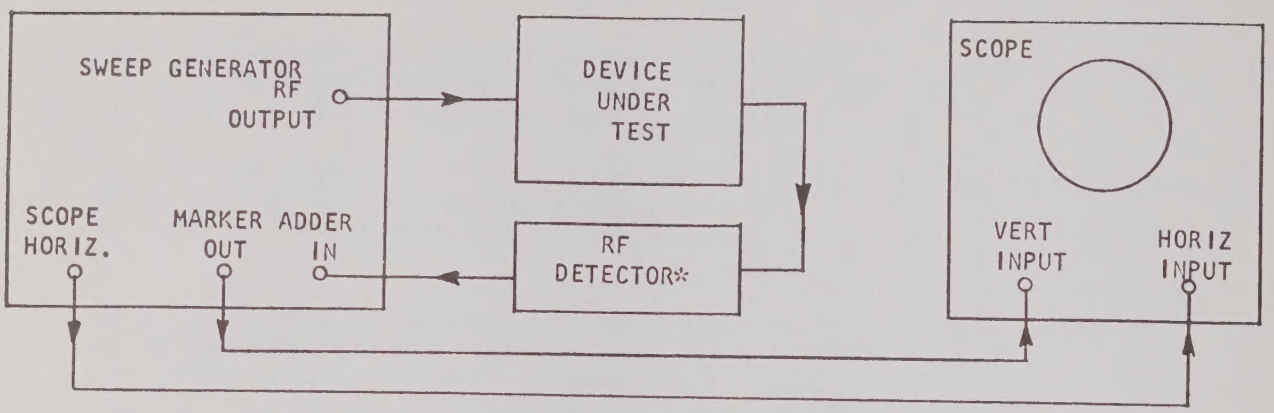
CHASSIS LAYOUT
Top View



V1	5651
V2	6AU6
V3	EL84/6BQ5
V4	EL84/6BQ5
V101	12AX7
V201	12AX7
V301	6AU6
V302	12AX7
V303	6AU6
V304	EL84/6BQ5
V401	12AX7
V402	12AX7
V403	12AX7
V404	12AX7
V801	12AV7
V802	12AV7

DESCRIPTION OF CHASSIS CONTROLS

R1 - B+ ADJUST	This control varies the bias on the amplifier, (V2), for the B+ regulator, (V3), and is adjusted to produce a regulated B+ voltage (B+2) of 175 volts.
R2 - SWEEP WIDTH LIMIT	This potentiometer controls a voltage supplied to the front panel SWEEP WIDTH control and is used to adjust the sweep width when the front control is set at maximum.
R101 - HORIZONTAL PHASE	This control adjusts the phase of the scope horizontal sweep voltage with reference to the phase of the sweep oscillator.
R102 - LINEARITY	This control can be used to change the waveform of scope horizontal output (V101) It is normally set for best linearity at maximum sweep width.
R103 - HORIZONTAL SIZE	This control adjusts the size of the horizontal output when the Front Panel Sweep Width control is set to its maximum position. It is adjusted to maintain a constant horizontal size at all sweep width settings.
R201 - BLANKING PHASE	This control adjusts the phase of the blanking pulse with reference to the phase of the sweep oscillator.
R202 - BLANKING WIDTH	This control is the grid resistor for the blanking pulse generator (V201) It is adjusted to blank one-half of the sweep cycle to produce a zero base line.
R301 - LEVEL MAXIMUM	This control is used to adjust the output level when the front panel LEVEL control is at its maximum position.
R302 - LEVEL MINIMUM	This control is used to adjust the output level when the front panel LEVEL control is at its minimum position. (On units that use no front panel LEVEL control the LEVEL MAXIMUM control on the printed circuit board controls the average B+ voltage supplied to the sweep oscillator and is used to adjust the RF output to a value as shown on the specification sheet. On these models the LEVEL MINIMUM control performs no function.)



TYPICAL SET UP - The following procedure is recommended for setting up this instrument in test position.

1. Connect unit to proper power line voltage and turn POWER ON switch to ON position.

2. Make connections to the scope, the device under test, and RF Detector as shown above. All connectors located on the sweep generator are BNC type and it is recommended that RG cable be used for all connections. This insures good ground connection between each device, minimizes hum, leakage from unit and pick up of spurious external signals. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator. If the input impedance of the device under test is different than the impedance of the sweep generator, a matching network should be used to insure a constant input signal.

3. Adjust the RF output level by means of the OUTPUT LEVEL or VERNIER ATTENUATOR control and the step RF ATTENUATOR to the proper input signal for the device being tested. Failure to do this will result in incorrect reading on the scope.

4. Adjust the SWEEP WIDTH control and center frequency SWEEP DIAL to cover the desired frequency range.

5. MARKERS
   Markers may be produced by one or more of the following methods depending on the specific unit.
   A. Plug-in crystal markers (C type).
   B. Plug-in crystal harmonic markers (CDH or CH type).
   C. Internal variable marker.
   D. External CW Signal.
   First turn on marker unit or inject external CW signal and adjust MARKER SIZE and SHAPER until markers are of a convenient size and width.

*See Telonic literature for detector recommended for use with this instrument.

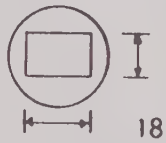
INTERNAL CONTROL ADJUSTMENT

THE INTERNAL CONTROLS are adjusted at the factory and normally do not require any readjustment, however, should it be desirable to check these adjustements, follow these steps:

1-Connect the unit as shown under operating instructions but omit the device under test. The recommended detector for this unit is the Telonic XD-8 for units with 50 ohm RF output impedance and the Telonic XD-9 for units with 75 ohm RF output impedance. Turn unit on.

2-B+2 ADJUSTMENT: Adjust R1 to provide a regulated B+ voltage of 175 volts (blue wire).

3-BLANKING PHASE and WIDTH ADJUSTMENTS: First set attenuator, switches and vernier for maximum RF output, SWEEP WIDTH control in its maximum counter-clockwise position and MARKER SIZE controls in their counter-clockwise position. A rectangular pattern should appear on the scope. If this pattern is not rectangular, adjust the BLANKING PHASE and WIDTH controls, R201 and R202, until a rectangular pattern is obtained.



Equal to Peak RF Output Approx.

18V. Approx.

A vertical line indicates no horizontal output, first check scope and connecting cables, then trouble shoot horizontal sweep section.

A horizontal line with zero amplitude indicates no RF output. First check scope, RF Detector, and connecting cables. Adjust R301 (see step 4). Refer to Maintenance, Page 13.

A horizontal line deflected above zero indicates no blanking. Trouble shoot the blanking generator.

BLANKING PHASE

Misadjusted

BLANKING WIDTH

Misadjusted

BLANKING PHASE & WIDTH

Misadjusted

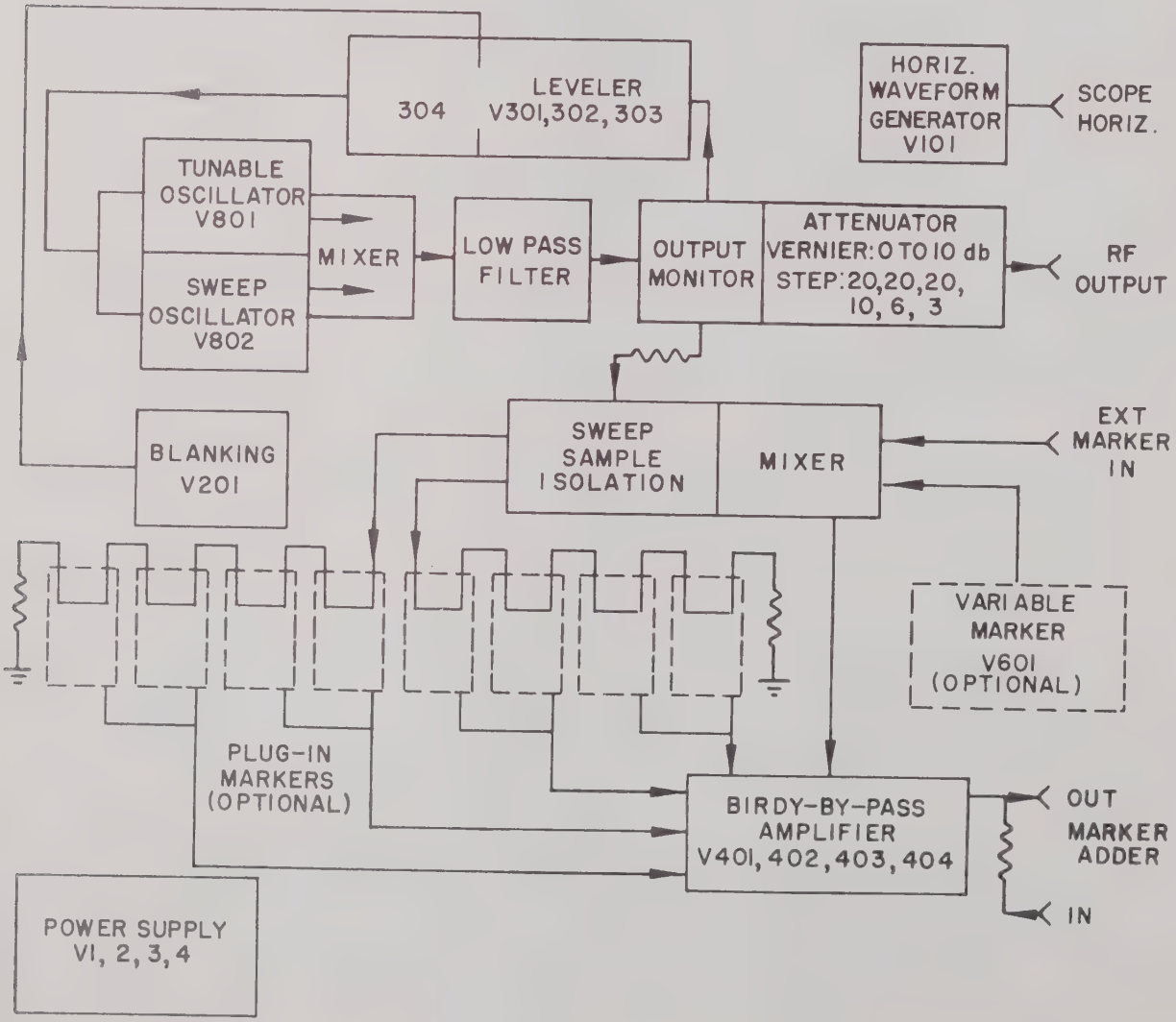
4-RF OUTPUT LEVEL ADJUSTMENT: Adjust LEVEL MAXIMUM control, R301, until the vertical height of the pattern equals the peak to peak RF voltage shown on the specification sheet, Page 1. Since the RF Detector is approximately 90% efficient, the actual RF output voltage will be slightly higher than the voltage shown on the scope.

5-HORIZONTAL PHASE AND SIZE ADJUSTMENTS: Set SWEEP WIDTH control to its maximum clockwise position. If pattern is not rectangular, adjust HORIZONTAL PHASE, R101, until a rectangular pattern is obtained. If the HORIZONTAL SIZE has increased or decreased, adjust HORIZONTAL SIZE, R103, until the pattern has the same horizontal size as it had with the SWEEP WIDTH control in its counter-clockwise position.

MARKERS MUST BE PROVIDED FOR THE FOLLOWING ADJUSTMENTS

6-SWEEP WIDTH ADJUSTMENT: With the SWEEP WIDTH control on the Front Panel in its maximum clockwise position, adjust the SWEEP WIDTH LIMIT, R2, to provide the maximum sweep width as shown on the specification sheet, Page 1.

7-LINEARITY ADJUSTMENT: Linearity may best be adjusted when a number of markers are present on the display. In the factory, a harmonic generator is used for this purpose. The LINEARITY control, R102, is adjusted for equal spacing between the markers. Adjusting the LINEARITY control will change the size of the Scope Horizontal Signal, therefore, the horizontal size must be readjusted (see step 5). The HORIZONTAL PHASE control also has an effect on linearity and can be adjusted slightly to obtain optimum linearity.



SWEEP OSCILLATOR AND MIXER CIRCUITRY

The output of this unit is produced by the heterodyne method using two oscillators at a frequency of 3 or 4 times the highest output frequency. One oscillator is swept to produce the sweep width and the other oscillator is tuned to allow the center frequency of the output to be tuned. Four diodes in a bridge circuit produce the mixing of the two fundamental frequencies. Due to the balanced nature of this mixer, a high output is produced with a minimum of harmonic or spurious content. A low pass filter removes the fundamental frequencies and allows the output or heterodyne frequencies to pass out through the monitor and attenuator to the final output. The oscillator circuits are similar, and have similar frequency versus voltage and frequency versus temperature effects to minimize drift.

HORIZONTAL SWEEP OUTPUT CIRCUITRY

The horizontal sweep voltage is originated by a square wave producing circuit. The 6.3 V. "A" winding and 6.3 V. "B" winding of the power transformer are connected in series to obtain a 12.6 voltage center-tapped to ground. This voltage is connected through a phasing network to the grid of V101 (12AX7). The tube then clips and amplifies the grid signal so that a square wave is produced at the plate. This square wave is then applied to the second triode through an RC network. This network is designed to produce a non-linear sawtooth waveform. A potentiometer in this circuit allows the shape of the waveform to be adjusted. The second triode is connected as a cathode follower, and produces the same sawtooth output. This horizontal sweep voltage compensates for the non-linear characteristics of the vibrating sweep capacitor at high sweep widths.

At sweep width from minimum to about 50%, the vibrating sweep capacitor is quite linear. In order to maintain almost perfect linearity for all values of sweep width, a potentiometer is ganged with the sweep width potentiometer which automatically changes the scope horizontal sweep voltage from a sinusoidal waveform at low sweep width settings to a distorted sawtooth waveform at the high sweep width settings.

BLANKING CIRCUIT

The purpose of the blanking circuit is to produce a zero base line by removing B+ from the Sweep Oscillator during the sweep retrace. The blanking voltage is originated by a square wave producing circuit. A phased 6.3 volt sine wave is squared and amplified by the blanking tube. This square wave output of V201 controls V304 (EL84), the sweep oscillator voltage regulator tube, and thus deprives the Sweep Oscillator of voltage during one-half of each cycle. PHASE and WIDTH controls are provided for adjusting this blanking voltage.

AUTOMATIC OUTPUT LEVELING CIRCUITRY

The RF output from the Sweep Oscillator is monitored by a crystal diode detector. This detector, which is located inside the attenuator box, consists of two diodes in a half wave voltage doubler circuit. The use of a voltage doubler provides higher voltage and prevents erroneous leveling information from occurring due to harmonic content. The detector provides a negative output which is equal to approximately 75% of the peak to peak RF voltage.

The output from the detector is then amplified and used to control the plate voltage of the Sweep Oscillator. A small decrease in the detector output causes a

large increase in the B+ supplied to the RF Oscillator and thus counteracts any amplitude variation.

The LEVEL MAX control adjusts the bias on the first stage of the amplifier. This causes the DC levels in the entire amplifier to change, and varies the average B+ supplied to the Sweep Oscillator from a minimum of 25 volts to over 100 volts.

The operation of this circuit and of the Sweep Oscillator can be checked at the feed-thru capacitor on the end of the Attenuator box or Pin 1 of V301. The waveform at this point will normally show a flat output level over the entire band. Adjusting the OUTPUT LEVEL will change this level.

POWER SUPPLY

The power transformer output of 140 volts AC is fed into a half wave voltage doubler, using silicon rectifying elements CR1 and CR2. B+ is taken off the capacity input filter to provide +375 volts unregulated to the plates of V3 (B+ regulator pass tube), V304 (oscillator pass tube), and V4 (marker B+ pass tube.)

B+2 is the output of the electronic regulator circuit, consisting of V2 and V3, and provides +175 volts regulated. Potentiometer R1 controls the operating point of V2, regulator amplifier, and is set for proper B+2 output voltage.

B+3 is obtained by biasing the grid of V4 at approximately 85 volts positive, which causes current to flow through cathode resistor R20. The voltage at Pin 3, V4, is supplied to the Plug-In Markers and maintains its regulation due to the low impedance characteristics of the cathode follower circuit and provides approximately 100 volts.

The B- voltage is obtained by the half wave Silicon Rectifier CR3. Regulator tube V1 maintains this voltage at -82 volts, and supplies bias voltage to the leveler circuit as well as a reference voltage for the electronic regulator.

Resistor R4 acts as a fuse, protecting the transformer and rectifiers from overload.

The primary of the power transformer is normally wired for 115 volt AC line operation. However, it can be converted to operate from a 230 volt AC source if desired. This conversion is described in the Maintenance Section.

MARKER SYSTEM DESCRIPTION

GENERAL

A sample of the sweep signal is mixed with the fundamental or a harmonic of the crystal plug-in marker units or external signal to produce beatnotes or birdies. These birdies are then amplified and superimposed upon the demodulated swept signal and applied to the vertical amplifier of the oscilloscope. The size and shape of the marker may be varied over a wide range by the SIZE and SHAPER Control of the birdy amplifier.

EXTERNAL MARKER INPUT

The CW signal from the external marker input is fed into a diode mixer, where it is mixed with a sample of the sweep signal to produce birdies. The resultant birdy is then fed into the birdy-by-pass amplifier.

PLUG-IN MARKERS

This unit has provisions for a maximum of eight single-frequency (C type) crystal markers or four harmonic (CDH type), or any combination. Each CDH type marker occupies the space of two C type.

SINGLE FREQUENCY MARKERS (C TYPE)

These crystal markers are self-contained plug-in units. Additional units at other frequencies (within the range of the sweep generator) may be ordered and substituted for the original units.

The crystal oscillator units include the tube, crystal oscillator tuning, crystal diode mixer, and a tuned circuit selecting the sweep input frequency. A test point is provided for easy adjustment of the overtone crystal oscillator (this circuit used above 12 mc.). In making this adjustment, the crystal oscillator coil slug is adjusted for near maximum voltage at the test point. This is usually in the order of 2-5 volts as measured with a VTVM. The adjustment should be made just slightly off the peak on the low inductance side, since the effects of tuning are critical on the other side of the resonance curve. Crystal oscillators below 12 mc. are Pierce type oscillator circuits which require no tuning.

By tuning the sweep sample coil, the frequency of the sweep input signal can be varied and thus minimize unwanted markers generated from other harmonics of the crystal oscillator. The amplitude can be varied by adjusting the coupling.

HARMONIC MARKERS

The Telonic CDH type marker uses two tubes and occupies two of the plug-in positions on the marker strip.

In this marker unit, harmonics of the signal from a crystal-controlled oscillator are mixed with a portion of the sweep signal to produce a display of markers at regular intervals across the sweep range. Satisfactory markers are produced to over 1000 Mc in most of these units.

See our literature on plug-in markers for additional information.

POWER SUPPLY: Since a defect in the power supply will affect all circuits, it should be checked for proper operation before proceeding to other circuits.

SUPPLY	NOMINAL VALUE	NORMAL VARIATION	NORMAL RIPPLE	WIRE COLOR*
AC Line	115V	----------	------	------
B+1	375	±15 Volts	6 to 15 volts	Red
B+2	175	±.5 Volts	12 to 25 millivolts	Blue
B+3	100	±5-10 Volts	15 millivolts to .5 volts	Orange
B-	-82	±2 Volts	100 millivolts	White
6.3 "A"	6.3V AC	Main filament supply		Green
6.3 "B"	6.3V AC	180° out of phase with supply "A". Source of phasing and filament voltages.		Gray
6.3 "C"	6.3V AC	Isolated filament voltage for tubes with cathodes above ground.		Brown

NEXT: If power supply is operating normal, use the block diagram to isolate the trouble to a major section. Check tubes, diodes, and adjustment of Front Panel and printed wiring board controls located within that section (see Page 7 for adjustment procedure). By the use of the schematic, ordinary difficulties encountered can be readily located and remedied. The following trouble-shooting chart is an additional aid to servicing:

SYMPTOM	POSSIBLE CAUSE AND REMEDIES
Pilot Light Off and Unit Fails to Operate	Fuse open - replace. If second fuse opens - look for cause of overload, shorted wiring, components, etc.
B+1 Off Value or Excessive Ripple	Check R4, C1, C2, CR1, and CR2.
B+2 Off Value or Excessive Ripple	Check R1 for proper adjustment. Check R15, it will burn out if B+2 is overloaded. Check V1, V2, V3, tubes and circuitry.
B+3 Off Value or Excessive Ripple	Check R17 and R21 (these resistors adjust the voltage on the grid of V4, a cathode follower, which in turn determines the voltage on the cathode). Check R18 (this resistor will burn out if B+3 is overloaded). Check V4 and C2.
B- Off Value or Excessive Ripple	Check C3, C4, C5, CR3, R3, R5, and R6. Check V1 to see if it is lit properly (should be a steady orange glow).

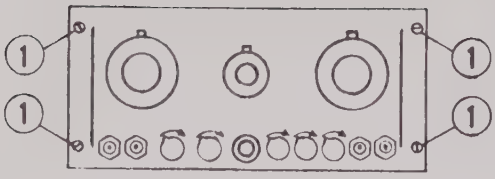
*Wire colors do not apply to shielded wires - single wires only.

V1 Not Lit Properly	If replacing V1 and checking the above parts does not remedy the trouble, check the line voltage. Low line voltage could cause this trouble. Reducing the value of R3 slightly will usually eliminate this difficulty.
RF Output is Low or Zero	Check R314 - this resistor will burn out if the B+ to the Sweep Oscillator is overloaded. Check B+ to the Sweep Oscillator, cathode of V304. It should be a positive square wave of 25-100 volts and should vary as the OUTPUT LEVEL control varies. If it is normal, look for RF difficulties, defective tube, components, shorted or open wiring, etc. Replace mixer diodes in sweeper box, observe polarity. If the voltage is low and does not respond to the LEVEL control, remove first V303 and then V201. When either of these tubes conducts, the voltage on the grid of V304 (pin 2) is reduced and thus decreases the B+ to the Sweep Oscillator. If removal of V201 allows the B+ on V304 (pin 3) to return to normal, check the blanking tube, controls, and associated circuitry. If removal of V303 causes the B+ to return to normal, check the LEVELER controls, V301 and V302, tubes, and associated circuitry.
Poor Leveling	Replace monitor diode. Also replace V301, V302, and V303. V301 is the most critical since it is in the first stage of the DC coupled amplifier. Resetting the printed circuit LEVEL controls is sometimes necessary if these tubes are replaced.
Weak Markers	Replace IN82 or IN34 crystal diode mixer. Check Birdy-By-Pass Amplifier, tubes and circuitry.
No Horizontal Output	Look for difficulty in the sawtooth circuitry V101, using the printed circuit board layout and schematic to check waveforms and voltages.

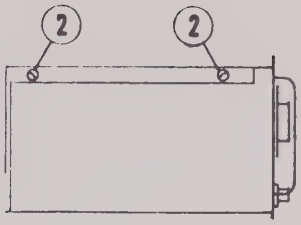
CONVERSION FOR 230 VOLT POWER LINES

The dual primary of the power transformer is normally wired in parallel for use with 115 volt AC lines. The windings can easily be reconnected in series for use with 230 volt power. With the aid of the Chassis Layout, bottom view, locate terminals 1, 2, 3 and 4. Remove the jumper wires from terminals 1 and 2 and terminals 3 and 4. Connect a jumper wire between terminals 2 and 3. Remove the 2 amp fuse (F1) and replace with a 1 amp Slo-Blo fuse.

RACK MOUNTED UNIT



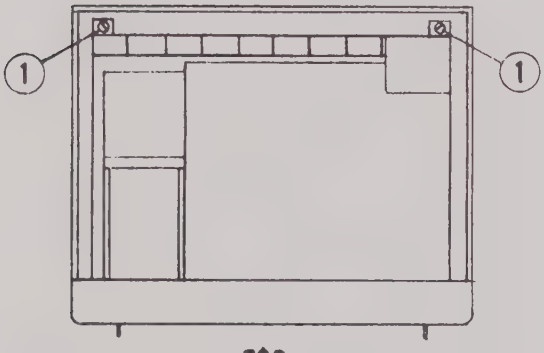
FRONT



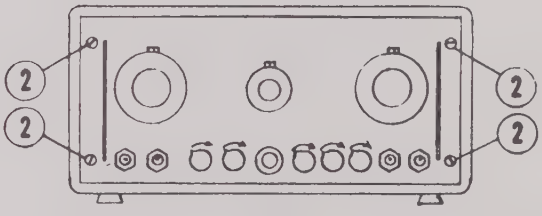
SIDE

Unit has front panel slotted or drilled for standard RTMA Mounting. Position unit in rack and install mounting screws in holes marked 1.
Dust cover removal: Remove four #8-32 thread-cutting screws, marked 2 (two on each side) and lift off cover for easy access to chassis.

CABINET MOUNTED UNIT



TOP



FRONT

To remove chassis from cabinet; first remove the two #8-32 screws (marked 1 on top view above) at the back of the chassis (one on each side). These screws fasten the chassis to the cabinet guide rails. Second, remove the four #10-32 screws (marked 2 in front view above). The screws hold the panel to the cabinet.

Slide chassis out of cabinet by pulling forward on the two front panel handles.

To replace chassis in cabinet, insert the flanges on the bottom of the chassis side panels into the slot of the cabinet guide rails. Push chassis back into cabinet far enough for the slots in the side panel flanges to align with the retained nut in guide rail. Install the two #8-32 screws and tighten securely. Replace the four #10-32 screws in the front panel.

PART VALUE INFORMATION

SCHEMATIC PART DESIGNATION	
C	Capacitor
CR	Crystal Rectifier, Germanium Diode
F	Fuse
I	Incandescent Pilot Light
J	Jack or termination, Coaxial Connector
K	Cable
L	Coil
M	Meter or Motor
P	Plug, Coaxial Connector
R	Resistor, Fixed or Variable
S	Switch
T	Transformer
V	Tube
Z	Miscellaneous

SCHEMATIC VALUE ABBREVIATION	
Ω	ohms
KΩ	1,000 ohms
MΩ	1,000,000 ohms (megohms)
µf, uf	Microfarad
pf	Picofarad
µh, uh	Microhenry
mh	Millihenry

RESISTORS - All resistors are 1/2 watt ± 10%, and are shown in ohms, unless otherwise specified.

NOTE: Resistors in the attenuator pads are ± 2%.

CAPACITORS - All Capacitors are shown in picofarads (pf) unless otherwise specified.

COILS - All coils are shown in microhenries (µh) unless otherwise specified.

PARTS LOCATION - F.P. Front Panel
P.C.B. Printed Circuit Board
R.P. Rear Panel
C.H. Chassis
T.P. Test Point

PARTS NUMBERS - LOCATION INFORMATION

1 - 99 - Power Supply
101 - 199 - Horizontal and Alternate Sweep Drive Circuit
201 - 299 - Blanking
301 - 399 - Leveler
401 - 499 - Birdy-By-Pass
501 - 599 - Mixer & Plug-in Markers
601 - 699 - Variable Markers
701 - 799 - Attenuators
801 - 899 - Sweep Oscillator and Sweep Drive Circuit
901 - 999 - Modifications and Special Circuits

*Indicates value of component adjusted at factory, and may deviate from value shown on print.

—○— Indicates printed circuit board terminal.

NOTICE

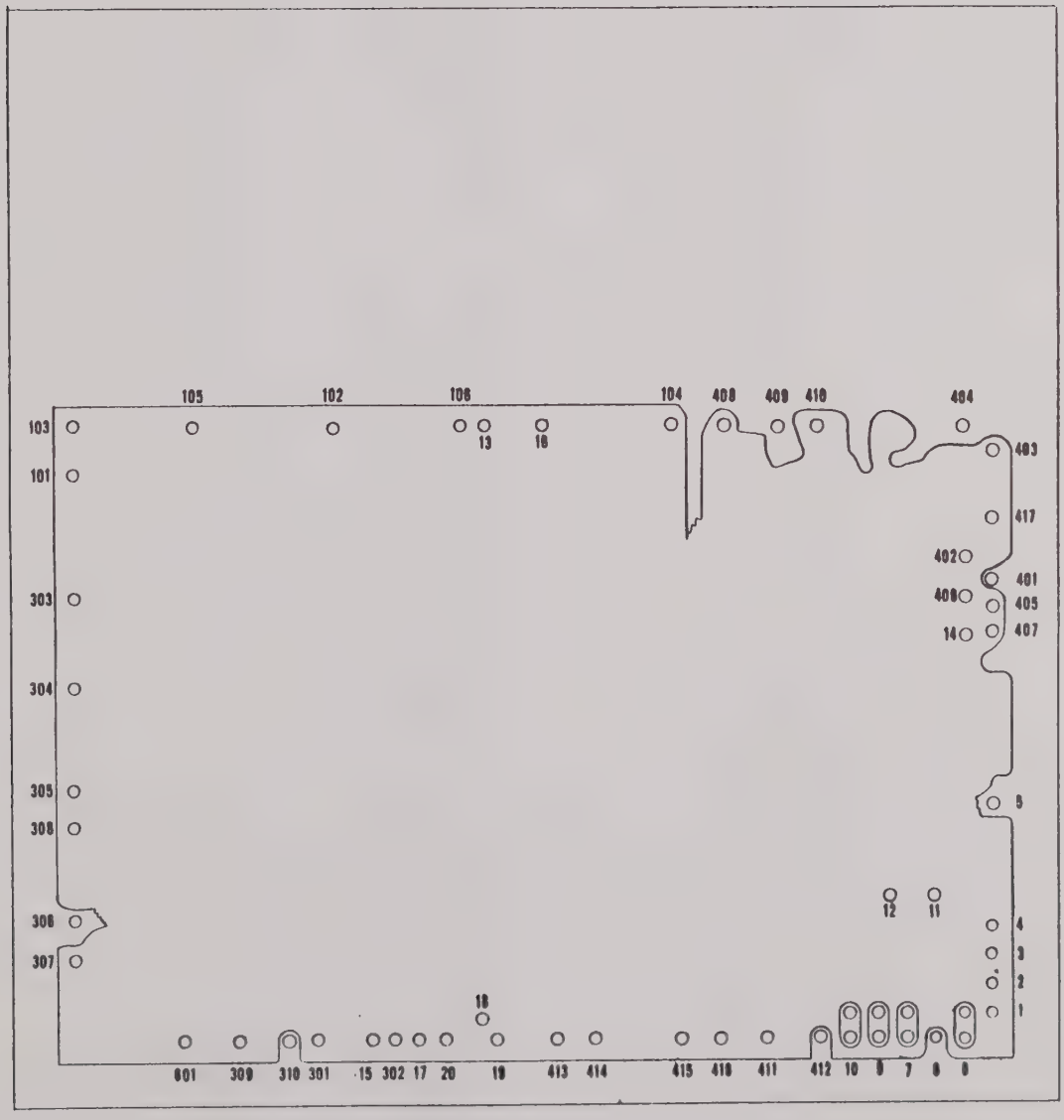
RED LACQUER IS USED TO INDICATE FASTENINGS THAT SHOULD NOT BE DISTURBED FOR ORDINARY SERVICE, AND TO SECURE ADJUSTABLE CONTROLS.

CHASSIS LAYOUT

BOTTOM VIEW

TERMINALS

FRONT



PARTS LIST

HD-7
(Less sweep oscillator and Attenuator sub-assemblies)

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
C1	CFE, 80μf, 250VDCW	C-314
C2	CFE, 80/20μf, 450/250VDCW	C-308
C3	CFE, 30μf, 250VDCW	C-313
C4	Same as C3	
C5	CFE, 30μf, 150VDCW	C-312
C6	CFP, 0.22μf, ±20%, 400VDCW	C-217
C7	Same as C6	
C101	CFP, 0.1μf, ±10%, 200VDCW	C-203
C102	Same as C101	
C103	CFP, 0.47μf, ±10%, 200VDCW	C-216
C104	CFC, 0.04μf, +80-20%, 500VDCW	C-53
C105	CFP, 0.0047μf, ±20%, 600VDCW	C-219
C201	Same as C101	
C202	Same as C101	
C301	CFC, 0.01μf, +80-20%, 500VDCW	C-20
C302	CFC, 50pf, ±10%, 1000VDCW	C-11
C303	CFC, 33pf, ±10%, 1000VDCW (SC)	C-10
C304	Same as C301	
C401	CFC, 120pf, ±10%, 1000VDCW	C-14
C402	Same as C301	
C403	Same as C301	
C404	Same as C301	
C405	CFC, 1000pf, 1000VDCW	C-19
C406	Same as C405	
C407	Same as C301	
C408	Same as C301	
C409	Same as C301	
C410	Same as C301	
C411	Same as C301	
C501	CFCF, 1000pf, 1000VDCW	C-39
CR1	DS, 1N2094	D-7
CR2	Same as CR1	
CR3	Same as CR1	
CR501	DS, 1N82	D-1
F1	Fuse, 3AG, 2a (115 VAC only)	MP-6
	Fuse, Slo-Blo 1a (230 VAC only)	MP-45
J101	RJ, 2545-1	J-10
J401	Same as J101	
J402	Same as J101	

HD-7 PARTS LIST

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
J501	TC, MX1684/U	J-9
J502	Same as J501	
J503	Same as J501	
J504	Same as J501	
J505	RJ, 2559-1	J-11
J506	NA	
J507	JRTA	J-23
J508	Same as J507	
P501	PC, UG-88B/U	J-32
P502 - P506	NA	
P507	Same as P501	
P508	Same as P501	
L1	#47	MP-5
L401	IF, 10mh	L-23
R1	RVC, 50KΩ, ±30%, 2/10W	R-725
R2	RVW, 25Ω, ±10%, 2W	R-713
R3	RFW, 7.5KΩ, ±5%, 5W	R-406
R4	RFC, 4.7Ω, ±10%, 1W	R-206
R5	RFC, 4.7KΩ, ±10%, 2W	R-306
R6	RFC, 1KΩ, ±10%, 1W	R-208
R7	Same as R4	
R8	RFC, 47KΩ, ±10%, 1/2W	R-27
R9	RFC, 47KΩ, ±10%, 2W	R-305
R10	RFC, 100KΩ, ±10%, 2W	R-303
R11	RFC, 1MΩ, ±10%, 1/2W	R-31
R12	RFC, 22Ω, ±10%, 1/2W	R-11
R13	RFC, 27KΩ, ±10%, 2W	R-304
R14	RFC, 180KΩ, ±10%, 1/2W	R-45
R15	RFC, 100Ω, ±10%, 1/2W	R-15
R16	Same as R15	
R17	RFC, 220KΩ, ±10%, 1/2W	R-44
R18	Same as R15	
R19	Same as R15	
R20	Same as R17	
R21	Same as R17	
R22	Same as R17	
R23	Same as R17	
R101	RVC, 200KΩ, ±30%, 2/10W	R-724
R102	RVC, 2MΩ, ±30%, 2/10W	R-729
R103	RVC, 100KΩ, ±30%, 2/10W	R-732
R104	SC	
R105	RFC, 150KΩ, ±10%, 1/2W	R-133
R106	RFC, 560KΩ, ±10%, 1/2W	R-29

HD-7 PARTS LIST

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
R107	Same as R11	
R108	PO R801	
R109	SC	
R110	Same as R17	
R111	SC	
R112	RFW, 4Ω, ±5%, 5W	R-410
R113	SC	
R201	Same as R101	
R202	RVC, 1MΩ, ±30%, 2/10W	R-728
R203	Same as R106	
R204	Same as R106	
R205	NA	
R206	Same as R106	
R301	Same as R1	
R302	Same as R1	
R303	NA	
R304	Same as R106	
R305	RFC, 10KΩ, ±10%, 1/2W	R-23
R306	Same as R11	
R307	Same as R8	
R308	Same as R106	
R309	Same as R305	
R310	RFC, 39KΩ, ±10%, 1/2W	R-26
R311	RFC, 100KΩ, ±10%, 1/2W	R-28
R312	Same as R305	
R313	RFC, 2.2MΩ, ±10%, 1/2W	R-34
R314	RFC, 82Ω, ±10%, 1/2W	R-54
R315	Same as R15	
R316	Same as R15	
R401	Same as R8	
R402	Same as R311	
R403	RFC, 4.7KΩ, ±10%, 1/2W	R-21
R404	Same as R8	
R405	RFC, 22KΩ, ±10%, 1/2W	R-24
R406	Same as R305	
R407	Same as R305	
R408	RVC, 100KΩ, ±30%, 1/3W	R-705
R409	Same as R311	
R410	Same as R403	
R411	Same as R408	
R412	RFC, 47KΩ, ±10%, 1W	R-210
R413	Same as R15	
R414	Same as R15	
R415	RFC, 1KΩ, ±10%, 1/2W	R-18
R416	NA	
R417	Same as R415	

HD-7 PARTS LIST

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
R418	Same as R15	
R419	Same as R15	
R420	Same as R415	
R421	Same as R415	
R422	Same as R408	
R423	Same as R403	
R424	Same as R311	
R425	RFC, 5.6KΩ, ±10%, 1/2W	R-22
R426	NA	
R427	Same as R305	
R501	RFC, 220Ω, ±10%, 1/2W	R-39
R502	RFC, 470Ω, ±10%, 1/2W	R-42
R503	RFC, 56Ω, ±5%, 1/2W	R-53
R504	Same as R503	
R505	RFC, 120Ω, ±10%, 1/2W	R-16
R506	Same as R505	
R801	RVW/C, 6Ω, 2W/100KΩ, 1/3W	R-736A
S1	SWT, SPST	SW-10
S501-S508	Same as S1	
S301	ASW, 3 pole, 3 position	NA
T1	TP	T-9A
V1	TE, 5651	VT-17
V2	TE, 6AU6	VT-5
V3	TE, EL84/6BQ5	VT-16
V4	Same as V3	
V101	TE, 12AX7	VT-13
V201	Same as V101	
V301	Same as V2	
V302	Same as V101	
V303	Same as V2	
V304	Same as V3	
V401	Same as V101	
V402	Same as V101	
V403	Same as V101	
V404	Same as V101	

HD-7 PARTS LIST

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
Z501-Z508	Socket, wafer	S-11
	Socket, 7-pin tube (4 required)	S-4
	Socket, 9-pin tube (10 required)	S-5
	Clip, diode	S-9
	Post fuse	S-27
	Assembly, pilot light	MP-3

HD-7
(Attenuator sub-assembly)

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
C701	CFCF, 1000pf, 1000VDCW	C-39
C702	CFC, 15pf, ±10%, 1000VDCW	C-7
C703	CFC, 1000pf, GMV, 1000VDCW	C-19
C704	CFM, 0.1μf, ±20%, 200VDCW	C-200
C705	SC	
C706	SC	
C707	SC (NS)	
CR701	DS, 1N34A	D-2
CR702	DS, 1N82	D-1
J701	TC, MX-1684A/U	J-54
J702	RJ, UG-185/U	J-6
J703	RJ, 2545-1	J-10
P801	PC, UG-88B/U	J-32
R701	RVC, 100Ω, ±10%, 2W	R-784
R702	RFC, 20Ω, ±5%, 1/2W	R-76
R703	RFC, 75Ω, ±5%, 1/2W	R-63
R704	RFC, 16Ω, ±5%, 1/2W	R-2
R705	RFC, 120Ω, ±10%, 1/2W	R-16
R706	RFCF, 61.9Ω, ±1%, 1/2W	R-818
R707	Same as R706	
R708	RFCF, 249Ω, ±1%, 1/2W	R-817
R709	Same as R706	
R710	Same as R706	
R711	Same as R708	
R712	Same as R706	
R713	Same as R706	
R714	Same as R708	
R715	RFCF, 95.3Ω, ±1%, 1/2W	R-816
R716	Same as R715	

HD-7 PARTS LIST

CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
R717	RFCF, 71.5Ω, ±1%, 1/2W	R-804
R718	RFCF, 150Ω, ±1%, 1/2W	R-814
R719	Same as R718	
R720	RFCF, 37.4Ω, ±1%, 1/2W	R-815
R721	RFCF, 294Ω, ±1%, 1/2W	R-812
R722	Same as R812	
R723	RFCF, 17.8Ω, ±1%, 1/2W	R-813
S701-S706	SWT, DPDT	SW-3
	Clip, diode (2 required)	S-9
Z801	Drive Motor	09013
Z802	Low-pass Filter	06002
	Socket, 9-pin tube (2 required)	S-58
	Clip, Diode (4 required)	S-9

HD-7
(Sweep Oscillator sub-assembly)

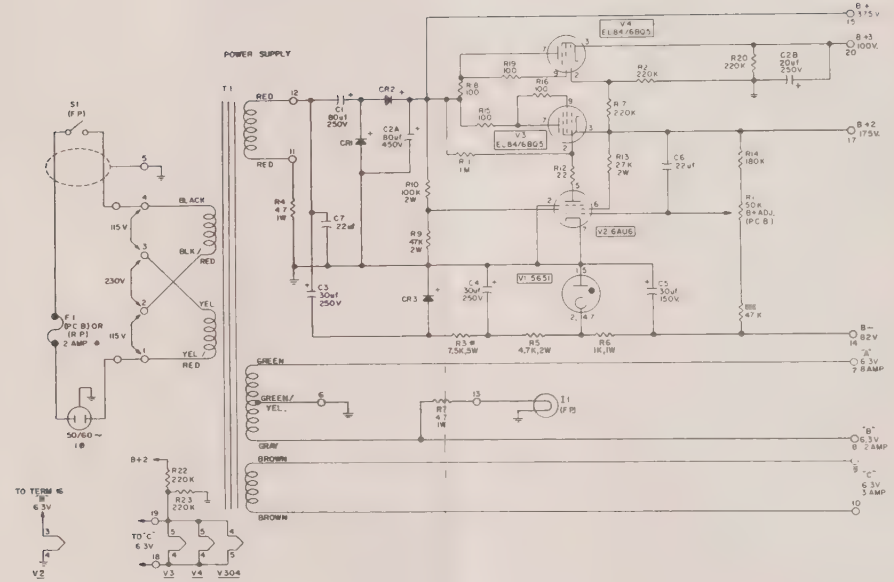
CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
C801	CFCF, 1000pf, +100-0%, 500VDCW	C-110
C802	Same as C801	
C803	Same as C801	
C804	CFCF, 1000pf, 1000VDCW	C-39
C805	Same as C804	
C806	Same as C804	
C807	Same as C804	
C808	CFC, 20pf, ±10%, 1000VDCW	C-8
C809	CFC, 10pf, ±10%, 1000VDCW	C-6
C810	CFC, 25pf, ±10%, 1000VDCW	C-9
C811	CVC, .5-4.5pf	C-43
C812	CFN (SC)	
C813	Same as C809	
C814	CFC, 5pf, ±10%, 1000VDCW (SC)	C-4
C815	Same as C808 (SC)	
C816	CFCF, 10pf, ±1%, 500VDCW	C-45
C817	Same as C816	
C818	CFC, 0.01μf, +80-20%, 500VDCW	C-20
C819	Same as C818	
C820	CFC, 4pf, ±10%, 1000 VDCW	C-3
C821	CFC, 100pf, 1000 VDCW	C-19

HD-7 PARTS LIST

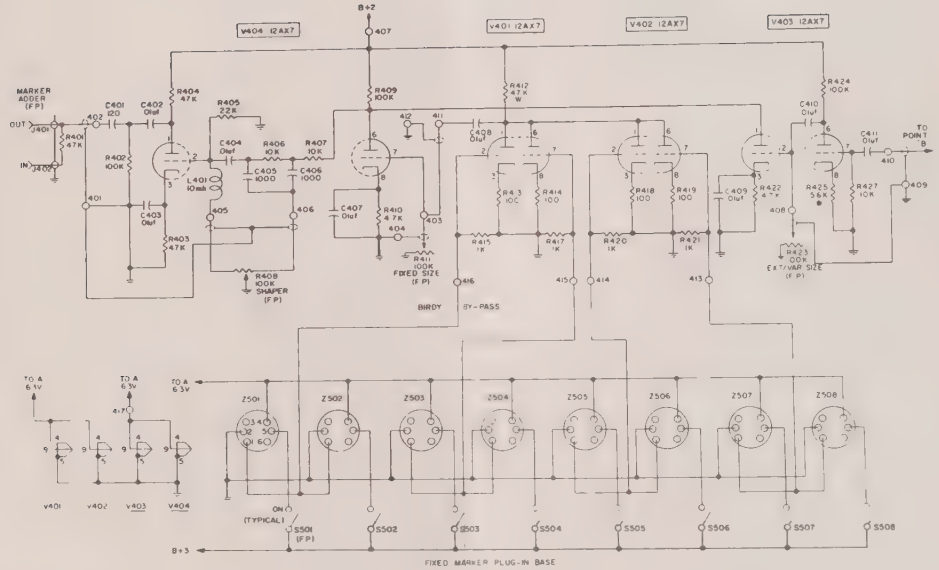
CIRCUIT REF.	DESCRIPTION	TELONIC PART NO.
CR801	DS, 1N34A	D-2
CR802	Same as CR801	
CR803	Same as CR801	
CR804	Same as CR801	
J801	RJ, UG-261B/U	J-16
L801	IF, 2.2μh, ±20%	L-100
L802	Same as L801	
L803	Same as L801	
L804	Same as L801	
L805	Same as L801	
L806	Same as L801	
L807	IF (SC)	NA
L808	IV	09012
L809	Same as L801	
L810	Same as L801	
L811	Same as L801	
L812	Same as L801	
L813	Same as L801	
R802	RFC, 1KΩ, ±10%, 1/2W	R-18
R803	Same as R802	
T801	Transformer, RF	09051
T802	Transformer, RF	09052
V801	TE, 12AV7	VT-12
V802	Same as V801	

ABBREVIATION CODE

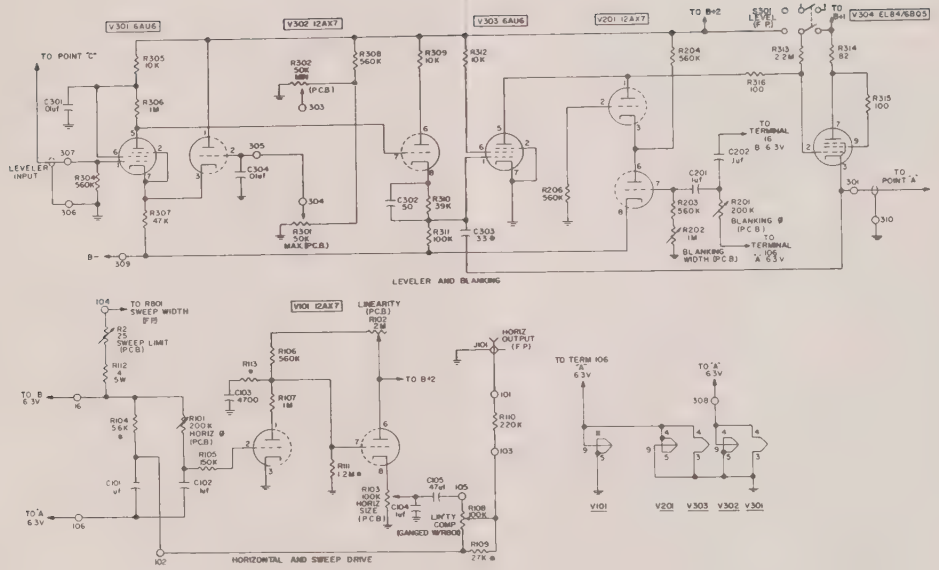
ASW	Assembly, switch
CFC	Capacitor, fixed, ceramic
CFCF	Capacitor, fixed, ceramic feed-thru
CFE	Capacitor, fixed, electrolytic
CFN	Capacitor, fixed, composition
CFM	Capacitor, fixed, Mylar
CFP	Capacitor, fixed, paper
CVC	Capacitor, variable, ceramic
DS	Diode, semiconductor
IF	Inductor, fixed
IV	Inductor, variable
JRTA	Jack, resistive terminating assembly
LI	Lamp, Incandescent
NA	Not assigned
NS	Not on schematic
PC	Plug, cable
PO	Part of
RFC	Resistor, fixed, composition
RFCF	Resistor, fixed, carbon film
RFW	Resistor, fixed, wirewound
RJ	Receptacle, jack
RVC	Resistor, variable, composition
RVW	Resistor, variable, wirewound
RVW/C	Resistor, variable, wirewound/composition
SC	Subject to change
SWT	Switch, toggle
TC	Terminating, cable
TE	Tube, electron
TP	Transformer, power



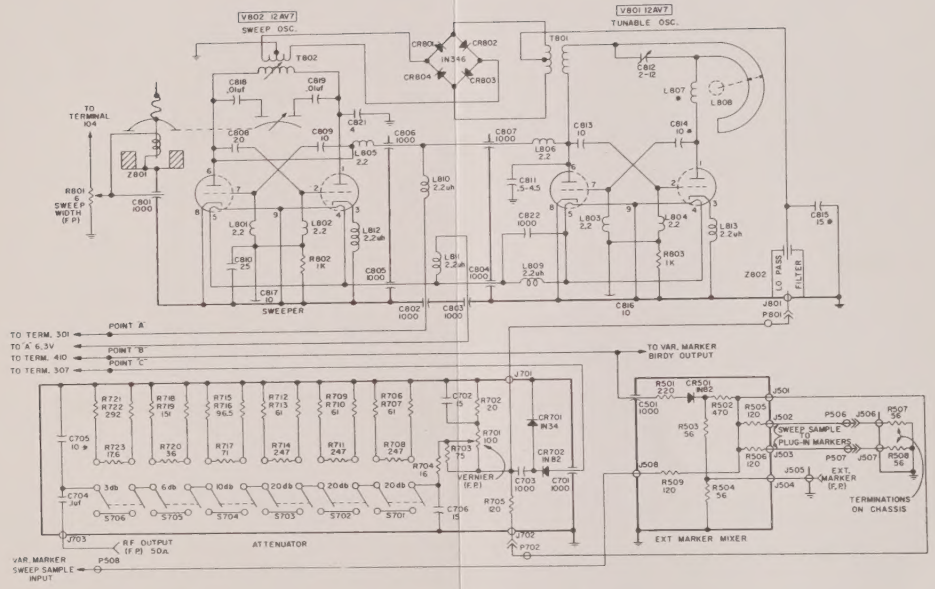
HD-7 Schematic (Sheet 1)



HD-7 Schematic (Sheet 2)



HD-7 Schematic (Sheet 3)



HD-7 Sweep Oscillator